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THE WORLDVIEW APPROACH TO CRITICAL THINKING

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ABSTRACT

The material in this paper will be useful to teachers interested in presenting controversial issues in their classroom. The Worldview Approach to Critical Thinking is about teaching students the interpretive process, which involves learning critical thinking skills by the use of controversial topics. The premise of the approach is that beliefs (worldviews) are an integral part of the interpretive process. It involves three major concepts: a) the dividing of science into two major categories: Empirical and Historical, b) the effects of the worldview on interpretation, and c) how to evaluate different worldviews for their validity. Finally, an attitude of openness needs to be a part of the classroom atmosphere.

INTRODUCTION

A failing of many science courses is that they do not teach students how to interpret data; rather they teach the student what the accepted interpretation is. It is then the student's responsibility to memorize that interpretation, yet rarely are they ever exposed to any other possibilities. The supplemental material provided by this approach addresses that deficiency. The use of controversial topics is an important aspect, because it is the vehicle used to teach critical thinking skills.

The underlying premise behind the worldview approach to critical thinking is that **beliefs are an integral part of the interpretive process.**

The worldview approach not only deals with **how to** interpret but also addresses the philosophical framework underlying that process. This approach involves supplemental material that can be woven into the context of any science course, or for that matter, any course that involves the interpretation of evidence.

The approach hinges on three major concepts:

(1) the dividing of science into two major categories: Empirical and Historical,
(2) the effects of the worldview on **all** interpretation, and
(3) how to evaluate different worldviews for their validity.

In addition, the teacher needs to cultivate an attitude of openness within the classroom. The plan is to take the reader through one school year and demonstrate how the three major concepts were incorporated into my physics classes. The object is to allow the reader to see how these concepts are presented within the context of my course. The material is geared for a physics course, but as was mentioned, it can be adapted to any course involving interpretation. The concepts will be introduced and defined in the same sequence that they are to my students. As appropriate, some background information will be interjected to allow the reader to share the same context that the students have when they hear the information.

The following is a brief overview of the sequence that will be covered.

(1) Introducing and defining the concepts.
(2) Through out the year, current and appropriate topics are examined from a worldview perspective.
(3) There are two papers: a discovery paper, by which a student discovers his worldview; and a research paper regarding origins and the effects of the worldview on interpretation.
(4) Sharing the instructor's worldview with the students.

After the approach has been covered student reaction, both positive and negative, will be examined.

BACKGROUND

Before getting into the meat of the material, I believe it is necessary to provide the reader with some background information. This topic needs to be removed from the ivory towers of textbook definitions and philosophical frameworks and into the real world where a person's emotions and perceptions play an essential part.

The classroom is not a sterile laboratory environment where I ring a bell and the students salivate. Rather it is an environment of human interactions. Remember Christy McAullife, the teacher who died in the shuttle explosion some years back? She is famous for the phrase, "I touch the future, I teach!" All teachers have the enormous responsibility of influencing the lives of their students. The students are not laboratory rats. They are real people and teachers need to be sensitive to their needs and perceptions.

In a similar fashion, there has been a great deal of personal and emotional involvement as this approach developed over the last twenty years. Therefore, before entering the classroom, I will provide you with some of my background experiences and observations, that in my perception, were important in the development of this approach.

INITIAL CONDITIONS

I was born in 1951 and had a middle class, Catholic upbringing; and in December of 1973, graduated from college with a Bachelor of Science in Education. My concentration was termed Comprehensive Science, which in theory, said I was qualified to teach any high school science. My first teaching assignment began in January of 1974.

I was a firm believer in evolution, not because I had examined the issue in detail; but rather, was not aware that other interpretations of the evidence existed. I was convinced that science had "proven" the FACT of evolution beyond a shadow of a doubt. At the time I was not even aware that there was a Creation - Evolution controversy.

My first teaching assignment was earth science and in line with the curriculum, in the spring of the year, I taught the students the evolutionary interpretation of the evidence. An interesting event occurred that first year. Two students came up and asked if they could have a debate between the Bible and science. In the interest of being open minded, we laid out some ground rules and had the debate. I recall sitting in the back of the room listening to the one student defend the Bible and thinking that she did not have a prayer (no pun intended) because evolution had been "proven" by science.

CHANGING WORLDVIEWS

The next year I made a decision for Christ, which was divorced from any scientific considerations. It was in the spring of the year and the evolution section of the course was coming up fast. However, deep in my heart I felt that the evolutionary ideas and my new found relationship were incompatible, but I had no idea how or in what way. I got together with an elder from my new church, who was a research scientist for NASA. We talked for several hours and the rock solid arguments that I had used for evolution over the years suddenly were riddled with holes. Unbeknownst to me I had **changed worldviews** and was now seeing the evidence from a different context. It was shortly thereafter that I became aware of the Creation-Evolution controversy. Beginning with that year I have tried a variety of methods to expose my students to more than one interpretation of the data.

DAD

For the last five or six years of my Dad's life, we would go on a two or three day trip every Easter break. Discussions would inevitably get around to Creation - Evolution. At the time I did not understand why he could not see that the creationist explanation was far superior to the evolutionists. Although several years earlier, I would have thought that the evolutionist's explanation was superior.

It was also a mystery to me how two equally qualified scientists could come up with such divergent explanations for the same evidence. I was under the impression that science could uncover definite answers that worked rather than just result in a variety of possible explanations.

Another topic would involve Biblical interpretation [4]. We would be discussing a particular verse and I would let him know what the "correct" interpretation was (my interpretation), and his standard reply was "that's just your opinion." To which I had no convincing reply.

A disturbing thought was that if the words of the Bible could be interpreted to fit any belief system [15], based on the opinion of the interpreter, then the Bible really says nothing at all. Not a comforting thought if the Bible is the authority in your life. There had to be some objective way to interpret data that would minimize opinion. Trying to find an objective way to interpret evidence was a principle factor in the development of this approach.

THE FIRST LIGHT

The first light dawned in January of 1987. In the Bible-Science Newsletter there was an interview with Charles Thaxton [1, p. 6]. In the interview he talked about dividing science into two broad categories: empirical and historical. One studied the current functioning of the natural world and the other studied the history of the natural world.

Talk about lights going off in your head. I had been through four years of college and thirteen years as a science teacher, five in earth science and eight in physics, was just finishing up my master's degree and I had never heard of such a division. NEVER! Since that time my observations have confirmed that very few people are aware of such a division. In contrast, instead of a sudden realization, discovering the worldview concept and its affect on interpretation and how to evaluate worldviews was a process that extended over the next four years.

INTO THE CLASSROOM

The '91 - '92 school year was the first time I piloted this approach in my classroom. Before I did however, I sat down with the school's administrator in charge of curriculum and laid out the procedure and rationale of what I was going to do and obtained approval.

The following are selected sections from the science philosophy of Lakewood High School:

(A) "As part of the understanding of scientific inquiry, students should learn the processes common to all fields of science." (One of those processes is the interpretation of data.)

(B) "Not only do we have a responsibility to allow students to question and search for their own answers, but also to provide them with scientific facts, inquiry and problem solving skills, and a desire to acquire new knowledge."

(C) "They must be able to collect and weigh evidence and apply this knowledge to practical situations through critical thinking in order to make their own decisions."

The Worldview Approach to Critical Thinking was tailored to fit this philosophy. An important part of this approach is that issues will be examined from multiple points of view.

If one foresees the need to deal with a controversial topic in the classroom it is a good idea to get administrative approval. In that way the administration is aware of the topic you are dealing with, Creation - Evolution in my case, and how you are presenting it in your classroom. Administrators, like most people, do not like surprises. Because the procedure involved a controversial topic, by obtaining approval ahead of time, later that first year when a parent did call the administration was supportive.

Several members of the English department were instrumental in helping to work out the mechanics of the research paper. They were also delighted that someone from another department was having the students do a research paper. They had no objections because a controversial topic was involved. A member of the Health department uses a modified version of this approach to help students understand where different values come from, and one other member of the Science department made the connection regarding the differences between empirical and historical science and has been pointing it out to his students ever since.

THE METHOD

Are you ready to get to class? Take out your notes, skip 5 lines, and put down today's date.

After the introductory material, the first topic covered is the Geocentric - Heliocentric controversy. The first week is spent teaching students about the motions of the heavenly bodies: sun, moon, stars and planets. After they get a feel for what is going on in the heavens we try to get a handle on the **why**: the cause behind the motions.

Putting yourself in the stationary frame of reference is most natural; therefore, an earth centered explanation is perfectly reasonable. The student will get a good rundown on the Earth centered system, also called the Ptolemaic system, with it's multiple epicycles that were used to explain the retrograde motion of the planets.

The students will be introduced to Aristotelian physics. That all things on the earth are made up of four basic elements: fire, air, water and earth, and there is one set of laws that governs how things work. **All** the objects in the heavens are made up of a fifth element called quintessence. There is also a different set of laws that governs how things work in the heavens, and never the twain shall meet. In my class the boundary separating the heavens and the earth is called the, **the wall**. To the people in that day it was very real.

The purpose of this background information is to set the context for the students, to help them understand some of the bits and pieces of the worldview that was in place just before Copernicus made his debut. After the students

are knowledgeable about how the heavens work, the prevailing explanations regarding why and some of the beliefs that were common at that time, Copernicus is introduced. For him to suggest a sun centered system was not just a simple change in a frame of reference. Rather, it involved rejecting common sense, direct observation, the current teaching's of philosophy and religion, and all of physical science [13, unit 2, p. 43]. Switching to sun centered meant that people would have to change their fundamental beliefs about reality. In other words they had to change worldviews. It is like an atheist becoming a fundamental Christian or vice versa. Everything you believed about reality has to be rethought.

Within the context of this controversy, the concept of a worldview is briefly introduced and how it affects one's understanding of the world. A worldview is an internal belief system about the real world - what it is, why it is and how it operates. Within a person's mind, it defines the limits of what is possible and impossible.

In "The Structure of a Scientific Revolution," Thomas Kuhn calls this changing one's belief about fundamental reality a paradigm switch [9, p. 158]. Once that switch is made, new avenues of thought are now possible. For example, before the Copernican revolution the concept of calculating the relative distances between the planets was not even a remote possibility. Even less of a possibility was that the other planets could be similar to the earth and that there might be creatures like us living on them. After the paradigm switch the preceding became valid areas of inquiry. A critical point is that even though the topic being studied, the repeating motions in the heavens, involves the current functioning of the natural world, one's belief system had an effect on the way one perceived reality.

After the introduction of Copernicus, the downfall of the Geocentric model and the rise of the Heliocentric is traced through the work of Brahe, Kepler, Galileo and Newton.

The Creation-Evolution debate is introduced as a modern day controversy within the preceding context; **but,** there are critical differences that need to be understood to fully comprehend the issues. Before examining any of the details regarding the debate, the differences between empirical and historical science are examined. To date only empirical issues have been under consideration. In other words, current functioning of the natural world, in particular the repeating motions in the heavens.

Current functioning (empirical or operational science) was the major emphasis during the formative years of modern science. Questions regarding origins (historical or origin science) were not an area of study or concern. When questions regarding the history of the natural world did begin to arise, no formal distinctions were made with respect to what was being studied and the method used; therefore, most people are under the impression that there is only one category of science, which was broadened a bit to include origins [5, p. 125]. But as will be demonstrated, the differences are significant.

EMPIRICAL SCIENCE

Empirical science involves the current functioning of the natural world. In other words, how do things work? It involves, what I call the four pillars of Empirical Science.

(1) *Direct Observation - seeing the process in action.*
The motions of the heavenly bodies.

(2) *Repeatability - in order to understand the process you have to be able to observe it more than once.*
The sun rises in the east, arcs across the sky and sets in the west, every day.
There are also seasonal variations, which constitute a pattern within a pattern.

(3) *Predictability - If you understand the process, then you should be able to predict the resulting effects.*
On any given day of the year you should be able to predict where and at what time the sun will rise.

(4) *Falsifiability - The description of the process should be stated in such a way that it can be proven false.*

The following example is used with my students. The two statements below are put on the overhead and the students are asked to decide which is scientific and which is speculation.

(1) Life exists only on earth. (2) Life exists in other parts of the universe.

Number two will be examined first. If one goes to Mars and finds that there is no life there, then life could be on Jupiter. If it is not on Jupiter, then it could be on Saturn or Neptune, or in the next solar system. If not in the next solar system, then maybe in the next galaxy. In other words, if you do not find it where you are presently looking, then it could always be just around the next corner. There is no way to prove it false. Statement number two is speculation. On the other hand, if one goes to some other planet and finds life there, then number one has been proven false (wrong). Statements regarding current functioning, by definition have to be very narrow and specific.

Also interpretive possibilities are limited. For example, in physics when distance time data is collected and plotted on a d-t graph and results in a straight line positive slope, that is constant velocity motion, end of discussion. In general, most scientists, regardless of their position on origins are in basic agreement regarding the current function of the natural world.

In empirical science, the word **proven**, as commonly understood, is applicable. The process in question can be experimentally observed and repeated; also the predictions can be verified. In other words, the truth or validity of the process or item in question has been established beyond doubt. Examples of **proven** theories include Newton's Laws of Motion, Laws of Electricity and Magnetism and Heat Flow. The results of basic empirical research have born much technological fruit in the areas of transportation, communication and medicine. These successes have led to the false perception that historical science can unravel the past with the same degree of accuracy. But as you will see, certainty is not a hallmark of historical science.

HISTORICAL SCIENCE

The scientist exploring the past is observing the effects and has to guess at what the process **might** have been. Many of the historical topics are singularities, one time events: the formation of the Earth, the carving of the Grand Canyon or the origin of life. These effects are singularities, which no one saw happen; therefore, there is no way of testing the actual process, whatever it may have been.

Historical science is, in a sense, like a forensic science. The investigator cannot test any of his theories against the actual crime. However, he can study a particular process under a variety of conditions and the resulting effects. If any of the studied effects match those on the victim, that would seem pretty convincing circumstantial evidence that a particular process may have been the cause. But unless the crime was observed, one cannot say for sure.

Historical science is a bit more complicated because the process in question did not happen in the present or close proximity; but happened in the unobserved past. It involves a process for which we have no experience. The formation of the earth, for example, would be analogous to a manufacturing process, like the assembly of an automobile. What we presently observe, however, is similar to the functioning and/or maintenance of the automobile after it is off the assembly line. These are two distinct phases and it is important to distinguish the differences between them. Man has access only to the functioning/maintenance processes, the manufacturing process, whatever it may have been, has yet to be observed. Therefore, any historical theories that are based on present processes involve a great deal of extrapolation. Can an actual Earth be formed under a variety of conditions in order to rule out various possibilities? Whatever erosional processes formed the Grand Canyon, no one observed it, and what has been produced in test tubes is far from alive and a great deal of intelligence has been involved in those experiments.

EXPLORING THE PAST

Extrapolation involves taking a present day process, **assume** all things remain the same, and extend that process into the past or future. In the Fall of the year, students are required to check the five day weather forecast against what actually occurs. It is no surprise when the forecast and the actual weather rarely match. The reason being the large number of unforeseen and unknown variables that cannot be taken into account in such a complex process. The further one moves from the present, the more problematic the unknowns. If the reliability of extrapolating five days into the future is questionable, then what about five months, or five years, or five million years? Will extrapolation work any better when trying to explain the past? At least with the future you can eventually check the extrapolation against what actually happens, but with the past there is no such luxury. Extrapolation has serious limits. Consequently, the initial assumptions and resulting conclusions should be critically evaluated rather than accepted without question.

Another method used to explore the past is historical records. When a historical record is used, the question of its historical and archaeological accuracy become dominant. If a particular record is found to be reliable in areas that can be verified, that is consistent with other historical sources, archeological findings and empirical facts, then that increases one's confidence that the record is factual even in areas that are beyond observable verification.

THE FOUR PILLARS

Regarding the four pillars, whatever process formed the Earth, it is beyond direct observation, thereby ruling out pillar number one. It is a singularity; therefore, it is not repeatable. Predictions, however, can be made in a certain sense. If a particular process was the cause then one would expect it to leave certain effects. Darwin predicted that there should be innumerable transitional forms in the fossil record based on his understanding of what he believed was the process. One problem is that even if the expected effects are found, since the process was never observed, one can never be sure that some other process did not produce the same effects. For example, homologous features can be explained as the result of common descent or common design. Two different

processes yet yielding the same effect. Convincing arguments can be made for both sides but since no one observed the process who can say for sure?

Finally, how does one write a statement about falsifiability regarding an unknown process that occurred once in the past? That raises another question, can a historical theory ever be truly falsified? In a historical theory, one is looking for broad consistencies or inconsistencies regarding the predicted effects. Because innumerable transitional forms are not found in one locality that does not falsify Darwin's theory. However, over time, as more and more localities also demonstrate an absence of the transitions, there would appear to be a definite inconsistency between the effects the theory predicts and what is actually found, thereby casting doubt on the theory. A historical theory is not "falsified" by a definite experiment or discovery like an empirical explanation. Rather, one is examining the effects and looking for consistencies or inconsistencies with regard to the theory. Consistencies strengthen the plausibility of the theory, while if the number of inconsistencies increases, then the theory needs to be modified or eliminated as new evidence comes to light. Another example is the Steady State theory regarding the origins of the universe. The theory suggests a continuous creation of matter, thereby maintaining a constant, homogenous universe in space and time. However, the observations did not match the predictions. The discovery of more and more radio sources the deeper one looked into space, which is assumed to be looking backwards into time, indicated a changing universe that is not homogenous throughout [10, p. 144-148]; therefore, the Steady State theory has fallen into disfavor.

TESTING HISTORICAL THEORIES

Historical theories **cannot be proven** in the empirical sense because the actual process or event is beyond experimental evaluation. However, disputes can be settled in a method similar to a lawyer presenting a case to a jury [17, chs. 13 & 12]. Evidence is presented along with a suggested explanation. Theories can then be evaluated in reference to their consistency with what is empirically known. For example, based on what we empirically know regarding the storage of information in systems of symbols, is DNA the product of random chance or intelligent design? The objective standard against which historical theories can be judged is our present understanding of current functioning, and how well a theory can explain observed effects and/or predict yet undiscovered effects. Historical theories **cannot be proven,** the best that can be said is that a particular theory is the most plausible. This point is critical and needs repeating, historical theories **cannot be proven,** the best that can be said is that a particular theory is the most plausible. **The key is plausibility not provability.**

In addition, the generation of a historical story is, in a sense, a chicken and egg problem. On the one hand, a person's belief about the past influences his interpretation; on the other hand, without a belief about the past he has no context that allows him to make sense of the data. Without the past as a context, a person is like one who has amnesia. He has no personal experience from which to draw; therefore, he must believe what others tell him, or he can make up his own story about what might have happened in the past.

To further emphasize the differences: Newton penned the laws of motion over 300 years ago. Those same laws are taught in physics courses all around the world. In contrast, since the discovery of dinosaurs many different theories have been suggested to explain their extinction [2, p. 117-126] and there does not seem to be an end in sight. Why does one seem unchanging and the other seems to be in a constant state of flux. Newton's laws involve current functioning while extinction theories are historical issues. Is it beginning to make sense why in some areas of science explanations never seem to change while in others the explanations are constantly changing? In historical theories, new information is always being uncovered and theories need to be adjusted or eliminated accordingly.

COMPARISON

Below are the two methods laid out side by side.

EMPIRICAL SCIENCE	**HISTORICAL SCIENCE**
Observe the process	**Observe the effects, guess at the process**
1. OBSERVATION 2. REPEATABLE 3. PREDICTABLE 4. FALSIFIABLE	1. GATHER EVIDENCE 2. GENERATE A STORY TO EXPLAIN THE EVIDENCE
TEST EXPERIMENT	**TEST** EVIDENCE / STORY PLAUSIBILITY (consistent with empirical knowledge)
Studying current functioning of the natural world	**Studying history of the natural world.**

As you can see, Empirical and Historical are not the same, what is studied and the methodology by which it is studied are very different. Once this distinction is recognized it becomes clear why in certain respects science can discover definite answers that work (empirical) while in other respects the best that can be accomplished is a plausible explanation of what **might** have happened (historical).

The Creation - Evolution controversy was introduced as part of the context to help students understand the critical divisions in science. Now that the divisions are understood, the controversy is reintroduced adding much more detail. The extreme positions are the emphasis. In the beginning matter, versus In the beginning God. Old earth versus young earth; uniformity of process versus global catastrophe; descent versus design. Students are made aware that shades of gray exist and in between positions are mentioned, but often times the differences between these positions can be subtle and confuse the main thrust; therefore, the emphasis is on the extremes. The extremes also help clarify **how belief and fact work together in the interpretive process.**

Take the Grand Canyon as an example. The evolutionist believing in an old universe and uniformity of process sees a canyon that formed slowly over millions of years. As supporting evidence, he will point to the present erosional rates of the Colorado river and extrapolate into the past. A creationist believing in a young universe and global catastrophe sees a canyon that is the result of a catastrophic erosional event. For supporting evidence he will point to the carving of the Little Grand Canyon that was produced by a mud flow, in one day, near Mt. St. Helens (March 19, 1982). He will envision a similar process having acted in the past.

ENTER THE WORLDVIEW

The worldview material is introduced within the context of the Creation - Evolution controversy. Notice that you have two very different scenarios to explain the Grand Canyon. What guiding principle allows one person to interpret the evidence one way and another person to interpret that same evidence so differently?

Recall what happened when Copernicus suggested a sun centered universe. Why was changing the frame of reference such a traumatic suggestion? Because it meant changing your entire belief system about reality - your worldview. As was demonstrated when discussing the Copernican revolution, one's perceptions about how the universe is **supposed** to work, influences how a person understands his world. The guiding factor is the worldview. The effects of the worldview are even greater in historical science because the actual event or process was never observed and more than one explanation is possible. In fact, the worldview affects all interpretation: scientific, religious, social and moral. The worldview is a very important part of the interpretive process.

The worldview is an internal belief system about reality. It is like a tinted pair of glasses that colors our perceptions of all of life's experiences; an internal standard against which the input received through our senses is evaluated. A worldview is not formally taught; rather, it is caught. We tend to unconsciously pick up the beliefs and values of the prevailing times and culture in which we live.

The following quote comes from a book entitled "2084: A Novel" and I think it hits the nail on the head. Dr. Larry Poland is commenting about scientific research; however, his comments have much broader applications.

> Do you really think there is any such thing as objective research? Honestly, now, have you really ever known a researcher who did not take tons of biasing baggage with him into his inquiry? Can you even postulate a person's being able to set aside all the lessons from his life experience, all of the blind socialization he has received from his culture, and all of his instinctive or learned predispositions? [12, p. 184]

This "biasing baggage" is a person's worldview.

As was already mentioned the worldview affects **ALL** interpretation, not only scientific. For example, is the Grand Canyon the result of a little bit of water and a lot of time or a lot of water and a little bit of time? How long was the Genesis DAY: 24 hours, a thousand years or an indefinite period of time? If you emerge unscathed from a terrible car accident: is the Lord's hand upon you, were you lucky or was it your karma? Is homosexuality an abomination or a viable alternative lifestyle? How you respond to any of the above is dependent upon your worldview.

The factious issues tearing apart our society are actually battles between worldviews [8, p. 35]. Debates over origins, sexual permissiveness, the breakdown of the traditional family, euthanasia, abortion, homosexual rights and the identity crisis are some of the major concerns. The student in the high school classroom rarely recognizes that all of these issues are interrelated. They are but side effects due to a changing context regarding prime reality. Dr. Francis Schaeffer, speaking about the above issues, laments that Christians "have failed to see that all of this (the factious issues) has come about due to a shift in world view - that is, through a fundamental change in the overall way people think and view the world and life as a whole" [14, p. 17]. Charles Colson recognizes the same cause and effect relationship. "Although the West is still called a "christian culture" by some, it is not. It is a distinctly post-Christian, dominated by a relativistic world-view" [3, p. 171].

The abortion controversy is a classic example. On one side, the Pro-choice people believe the fetus is just so much tissue that can be removed at the whim of the individual. The tissue is not considered to be a human being. Abortion is a basic human right, hence no crime is involved. On the other side, the Pro-life people believe the fetus is a living human being, at a very early stage of development, but no less valuable than a child or mature adult. Abortion is murder. Notice that the value and meaning of the fetus were assigned in accordance with the beliefs (worldview) of the one doing the beholding. Neither side seems to recognize that **they are examining the same item but measuring it from a different standard.**

WHAT STANDARD?

Consider the following analogy. Many years ago, before the massive increase of travel and communication there were two scientists from different countries, Dr. Aslong and Dr. Halfsize. They were both invited to attend a conference on standardizing the unit of length. Curiously, the standard of length used in both countries was called the "stadia." However, Dr. Standardlength, who organized the conference, was the only one who knew that even though the name was the same, the "stadia" from each country was a different length. Dr. Aslong's stadia was equal to our present day meter; while Dr. Halfsize's stadia was equal to only half a meter.

To make a pitch for a worldwide standard of measure, Dr. Standardlength had the two scientists independently measure his height. The results of which would be reported at the conference. Dr. Aslong reported the measurement as "2 stadia." While Dr. Halfsize reported the measurement as "4 stadia." The following conversation ensued. "Dr. Aslong, you must have made an error. We can both see that Dr. Standardlength is of average size, but your measurement makes him out to be a midget." "Not so!" replied Dr. Aslong, "I agree that Dr. Standardlength is of average height; however, your measurement makes him out to be a giant." "But Dr. Aslong," counters Dr. Halfsize, "it is so obvious that your measurement is in error. Why can't you understand that?" Dr. Aslong answers saying, "I'm just as frustrated as you are Dr. Halfsize. I agree that there is an error, but it is obvious that it is on your part." And so the conversation goes.

The problem is that they are examining the **same** item but measuring or evaluating it using different standards. As noted earlier, the same is true of the Grand Canyon, the Genesis day, emerging unscathed from a car accident or the homosexual issue.

The identity crisis is also linked to the worldview. Ultimate questions such as Who am I, Why am I here and Where am I going, all have different answers in accordance with the worldview of the one doing the answering. A biblical worldview sees man as created in the image of God. Secularism humanism understands man as having evolved from the animals and monism perceives man as being god. The diversity of answers is mindboggling?

Why do origin debates become so heated? Because they call into question the worldview of another. If it can be demonstrated that one's worldview is in error then that means that person has been living a lie and that is a hard pill to swallow.

Clearly, **a person's belief system is an integral part of the interpretative process.** In other words, evidence **DOES NOT** demand a particular interpretation; rather, a person's worldview demands the evidence be interpreted a particular way. When it comes to interpretation, the fly in the ointment is the interpreter himself, whose worldview influences the analysis.

PAST - PRESENT CONNECTION

When it comes to historical evidence the worldview provides the context for understanding the present. For example, have you ever watched a Nature special on PBS and out of the blue, the commentator begins recounting an origin scenario. He may talk about the Big Bang, common descent or natural selection. Why? He is setting a context for the listener. He is making sense of the present by grounding it in what he believes is the truth about the past. In the scriptwriter's mind it defines the limits of what is possible and impossible.

Because people have a variety of different beliefs about the past, they interpret evidence in a number of different ways. The question becomes, which past is the truth: evolution, creation, some combination or maybe endless cycles?

TRUTH

I like to use this analogy with my students. Think about your own life. From the time you were born until now there has been only one chain of events that has occurred. Each time you made a decision to follow a particular path a new link was formed; but do not lose sight of the fact that there is only one chain, not multiple chains. That chain of events is the truth about the your past. The argument can be extended to the very beginning of the universe. There has been only one course of events, not multiple courses, therefore only **one truth.**

What that means regarding worldviews is that **NOT ALL WORLDVIEWS ARE EQUALLY VALID!** The past-present connection is critical because it removes a worldview from the realm of personal opinion and connects it with the reality of what has happened and what is happening.

THE WORLDVIEW AND CRITICAL THINKING

The worldview is all encompassing, **there is NOT ONE area of interpretation that the worldview does not affect**. That being the case, it is in the student's best interest to learn to think in terms of worldviews. Very few of the students I teach are going to become scientists or engineers. However, all of them will have to come to grips with the issues facing our society and the ultimate questions. Students need to develop critical thinking skills such as analysis, synthesis, evaluation, distinguishing fact from opinion, identifying bias, judging the strength of an argument and determining the credibility of a source. The goal of worldview thinking is to help students become critical thinkers in contrast to parrots.

Recollect that for most people the worldview is caught, not taught. In other words, most people are not consciously aware of their worldview. Much like the foundation of a building, it is real, necessary but not highly visible. The result is that these internal values and beliefs are rarely ever questioned or evaluated concerning their validity.

A goal of the worldview approach is the discovering of one's worldview thereby exposing it for critical examination. Once the worldview is out in the open, another goal is to evaluate it and determine why one believes it is true in light of so many different options. Recall that the worldview is the internal standard used to assign meaning and value. Once a student understands the components that make up a worldview, he will then have the knowledge and tools to be able to discern something about the worldview of another, thereby, giving the student insight into why other people are reaching very different conclusions when examining the same evidence.

To accomplish these goals real issues need to be explored and that spells controversy. However, it is only by being exposed to foreign worldview that one begins to seriously consider his own. In the science classroom the Creation-Evolution debate provides such a vehicle.

WORLDVIEW COMPONENTS

What are the components that make up a worldview and how are they categorized? A worldview involves six components. First, because of the importance of the past-present connection one's stand regarding ultimate origins is crucial. This component forms the cornerstone upon which all the others rest. Second, what is the nature of man and how can the noble and depraved sides be explained? Third, what is death and what happens afterwards? Fourth, what is the nature of evil and suffering? Fifth, against what standard does one measure morals and ethics?

Finally, is history linear, cyclical or some combination?

One problem with worldview thinking is that if there are five billion people on the planet each having his own worldview. In that regard, worldview thinking seems a bit unmanageable. However, all worldviews have one thing in common, something is there. They differ in regards to the true nature of that something. Using ultimate nature as a guide it results in three possibilities [16, p. 17]: the fundamental essence of all things is a) matter; or b) spirit; or c) a combination of matter and spirit. Representative worldviews would be Atheistic Evolutionism, Eastern Monism and Biblical Theism respectively. Another method of categorizing worldviews is in regards to whether or not one believes in God. If one believes in God, the views can be subdivided into what type of G/god. My preference is using the ultimate nature of things.

The representative worldviews need to be defined so that everyone has the same understanding when those terms are used. A Biblical Theist begins with Scripture and interprets all data within that context. Reality has a material and spiritual component. Biblical interpretation is along fundamental, conservative guidelines. The starting point is a historical document. Atheistic Evolutionism denies a spiritual component. Impersonal, natural law is the maker of the universe and the extrapolation of present day processes is the rule. For the Eastern Monist one impersonal spiritual element constitutes all reality. "God is the cosmos. God is all that exists; nothing exists that is not God. If anything that is not God appears to exist, it is *maya,* illusion, and does not truly exist" [16, p. 140, italics in original].

When the concept of worldviews is introduced the following nine views are mentioned briefly: BIBLICAL THEISM, Deism, ATHEISTIC EVOLUTIONISM, Nihilism, Existentialism (atheistic and theistic), EASTERN MONISM, New Age and Animism. For the remainder of the year the three fundamental views, as noted above, are the predominate views under consideration and the students are given a more detailed look at each of those views as they relate to the six components that make up the framework of a worldview.

THE FUNDAMENTAL VIEWS

The following information is by no means the final word or all inclusive. Volumes have and will be written on each of these topics. One purpose is to expose the student to **the variety of responses** and their connection with the initial assumptions. As was pointed out at the conference, a way to strive for greater objectivity, than is listed below, is to obtain and document direct quotes from persons who hold the worldview being discussed. The object being to accurately represent each view under consideration.

The origin component of a worldview entails a **belief** about the initial conditions. In the beginning God, a Spirit, Who created the physical universe is a faith tenet the Biblical Theist believes because he has confidence in the credibility of a historical document. That in the beginning was a dense ball of matter before the Big Bang is a belief held by an Atheistic Evolutionist who subscribes to the backwards extrapolation of presently understood processes. Eastern thought is **radically** different from Western and entails many diverse beliefs. However, a common tenet is one of endless cycles as opposed to a distinct beginning. How one arrives at what the initial conditions may have been will vary, but the point is that what those conditions were is beyond empirical verification and accepted on faith. The initial faith assumption sets the stage for each worldview and upon that foundation everything else is built. Once the initial faith assumption is established, the other five components of a worldview are predictable if one is attempting to be consistent with the initial conditions.

The Biblical Theist believes man was created in the image of God and each human life has worth because it was reckoned so by the Creator. The noble and depraved sides of man are explainable due to the Fall. One man unselfishly risking his life for another is the Image dimly showing through, while another man involved in child pornography is a result of man's alienation from God. In contrast, the Atheistic Evolutionist believes man is fundamentally no different from all the other creatures on the planet. Man's depraved side is just a throwback of his animal ancestry and his noble side is still an enigma. The Eastern Monist believes that man is god and that noble and depraved are just two sides of the same coin.

The Biblical Theist believes death is the punishment for sin and that there was no death before the Fall. After death is judgment and heaven or hell is the final destination depending on what one has done with Jesus Christ. The Atheistic Evolutionist believes death is part of the process that brought man into existence and has always been; and when you are dead you are dead. For the Eastern Monist, death is part of the reincarnation cycle. Through this cycle of rebirths, he will eventually fuse with "ultimate reality."

To the Biblical Theist evil and suffering are intimately related to the Fall. There was a time when neither existed and there will be again, but our present situation is the result of a tragic choice. The solution is the cross. To the Atheistic Evolutionist evil is a term coined to foster superstitions and suffering is part of the selection process and has always been. The solution is the advancement of science and technology. According to the Eastern Monist there is only one ultimate reality; therefore, there are no distinctions between good and evil. Suffering is "Maya," illusion.

The Bible is the absolute, unchanging moral and ethical standard for the Biblical Theist. In contrast, the Atheistic Evolutionist believes that man is at the top of the evolutionary ladder and there is no transcendent standard; therefore, man determines the standard, which is subject to change. For the Eastern Monist, man is god, he can set his own standard and there is also no reason why it must remain fixed. The entire concepts of "right" and "wrong" are in reference to a standard. An issue plaguing society today is who has the **right** to make up that standard?

The Biblical Theist views the big picture of history as linear. Although there are internal cycles as civilizations oscillate between moral excellence and depravity. In contrast, when looking into the past or the future, the Eastern Monist perceives endless cycles. If an Atheistic Evolutionist believes in the Big Bang, the universe had a beginning, there is no particular purpose, and the working out of the natural laws will result in the heat death. On the other hand, if he believes in a oscillating universe or plasma cosmology, then endless cycles are the rule.

A key point about the above information is that it entails **beliefs** that cannot be proven in the empirical sense. How one arrives at their beliefs may entail a variety of methods: historical or religious documents, circumstantial evidence, authority figures or personal experience. Evidence that will convince one person may seem irrelevant to another. Yet each has faith that his position is true and he believes the supporting evidence is sufficient. This internal belief system (worldview) forms the context against which each of us makes sense of our world. In other words, **beliefs are an integral part of the interpretative process**. Accepting a position on faith is **NOT** intellectual suicide.

If students are to become critical thinkers, then it is important to recognize the influence of the worldview, even in a science classroom; recall that 1) empirical science is influenced by beliefs; 2) the interpretation of historical data is affected by the interpreter's world view; and 3) understanding a writer's belief structure gives the student insight into the "why" behind the explanations that appear in the text.

DECISIONS, DECISIONS, DECISIONS

Remember, based on the past - present connection not all worldviews are equally valid. Considering all of the different possibilities, how does one go about making an intelligent, evidence based, decision? Once the components of the worldview are understood then one can apply the most fundamental law of logic, the law of noncontradiction. "No two opposite statements can both be true at the same time and in the same sense" [7, p. 271]. For example, in a Biblical Theist's worldview, man cannot be an image bearer and have descended from other organisms (Gen 1:26-27; 2:7). Or in an Atheistic Evolutionary worldview, man cannot have a spiritual component that leaves the body and enters another phase of existence after death.

A worldview must also be consistent with what is empirically "known" about the physical universe and common human experience. Views that deny gravity or believe that human suffering is an illusion are inconsistent with what is empirically known. As was mentioned earlier Darwin predicted innumerable transitional forms would be found in the rocks of the earth. The absence of those transitional forms led to punctuated equilibrium theory, because gradualism was inconsistent with the data. In a like manner, the Steady State theory of the origin of the universe was abandoned because the deeper one looked into space the less homogeneous the universe became, which was inconsistent with the theory. The following example is more relevant to a high school student. If your boyfriend or girlfriend says that they love you and then you see them on a date with someone else, their actions are inconsistent with their words.

Consistency is the key. A worldview needs to be internally consistent, and externally consistent with what is empirically known about the universe. Also if an inconsistency is found one needs to determine whether or not it is apparent or real. A person should strive for the worldview with the fewest number of inconsistencies.

There are other tests. In addition, Nash [11, p. 57-63] uses the tests of practice and experience; while Geisler and Watkins [6, p. 231-241] include a fourth test called comprehensiveness along with some cautions about how not to choose a worldview. These items are very useful, but due to time constraints are not examined in detail. The law of non-contradiction is the primary focus.

100% OBJECTIVITY

Twenty years ago I set about trying to find an objective way of interpreting evidence. What I discovered was that a person's worldview is an integral part of the interpretive process. Therefore, I have concluded that one hundred percent objectivity, untainted by beliefs, does not exist. This was in conflict with the training I received at the universities, which left me with the impression that beliefs never or seldom enter into the interpretive process, especially where science is concerned. I trust that the preceding material has demonstrated the integral part that beliefs play in the interpretive process. However, one should **STRIVE** towards the goal of one hundred percent objectivity, and a very important part of that striving is a recognition of the worldview and it's far reaching effects.

OTHER TOPICS FROM A WORLDVIEW PERSPECTIVE.

The student has all the core information: the dividing of science into two major categories, how a worldview affects interpretation and how to choose among worldviews. In summary, beliefs are an integral part of the interpretive process. At this point, it is about three weeks into the school year and the core material took about one week to present. Now it is back to physics. The philosophical framework and the tools for evaluation are in place, as the year progresses, whenever a current and/or appropriate topic comes up in the news, some time will be spent examining it from a worldview perspective.

For example, one topic that was covered this year was Sex and the Worldview. December 15, 1993, was a national Aides day, and there was an all school assembly. Factual information about Aides was presented, but when it came to prevention, condoms was given about ten minutes worth of time and abstinence was mentioned in passing. It was confusing that the only sure method of prevention was passed over so casually. However, there is much more at stake. The disease is contracted primarily by sexual encounters; therefore, because of this means of transmission there are much broader consequences involved than just the prevention of a disease. It may entail the survival of society.

Sex was examined from two different worldview perspectives: Biblical Theist and Atheistic Evolutionist. Now the students have the opportunity of seeing the interpretive process in action. The emphasis, as always, was to show how and why, because of beliefs, very different conclusions are reached regarding the same item.

The stage was set by examining initial conditions: the nature of man, according to the Biblical Theist and the Atheistic Evolutionist. Next, how does each side define sex? What is it; why is it? Third, how would each side define sexual freedom and who makes up the rules regarding sexual conduct? What is the best way of preventing the spread of sexually transmitted diseases? Finally, marriage and family were investigated. Where did marriage come from? Why should there be marriage? What are the purposes of family? What, if any, are the responsibilities of being a part of a family? Is there a relationship between the health of society and the health of the family? Considering our nation, what have been some of the consequences of our changing views regarding sex? In my estimation, the discussions were fruitful and gave the students the opportunity to consider the issue from multiple perspectives.

The following are examples of some additional topics. The cover story of TIME magazine (November 8, 1993) was entitled "Cloning Humans." An additional question on the cover was "Where do we draw the line?" The June (1994) issue of National Geographic, on a page entitled "Geographica," had a column labeled, "Tyrannosaurus Sex: How Can You Tell?" Which brings up an interesting question, if you have never seen them in the flesh, how can you tell from only the bones? A good example of historical science and possible explanations. The cover story of TIME, March 14, 1994, was entitled "How Man Began? Fossil bones from the dawn of humanity are rewriting the story of evolution." Another good example of historical science and how the explanations keep changing as new information becomes available. The cover story of NEWSWEEK, June 13, 1994, was titled "The Politics of Virtue." This brings up the question of who defines the standard? The amount of time spent on any of these topics is up to the discretion of the teacher, from ten minutes to an entire period. In each case, the purpose being to show students how the worldview affects the way a person interprets the evidence, thereby helping students understand the interpretive process.

DISCOVERY PAPER

Sometime near the beginning of November the students are assigned a discovery paper. The purpose is to help (force) students to consider their positions on the six components that make up the worldview. For each of the six components the student needs to relate 1) what he believes, 2) the reasons why he believes it and 3) where he got that belief from initially. This is an opinion paper and it is stressed that the paper is graded based on the completeness of the answers, not on the content. The students are trying to discover their beliefs, not conform to any particular one. You will be amazed at the jumble of beliefs that students have tucked away in their hearts.

Once the students have had to work through these issues on their own and become familiar with the worldview components, they are now in a position to be able to discern something about the worldview of another. For example, if in the course of a conversation a person mentions things that happened in a previous life time, as casually as speaking about yesterday's dinner, it is very probable that the speaker has some New Age and/or Eastern leanings in their worldview. Or someone may profess belief in the Bible and is also convinced that an evolutionary process did occur, then that individual might be considered a progressive creationist or theistic evolutionist. Obviously, the minute bit of information in the above examples does not reveal another's worldview in all its complexity, but it will give the student some awareness regarding why a person handles issues or information a particular way. The same technique applies when reading literature or listening to a lecture.

RESEARCH PAPER

Near the beginning of the third grading period (end of January) a research paper is assigned dealing with the topic of origins. Of the six components, only origins lends itself to having an agreed upon standard, empirical knowledge, which can be used to evaluate different interpretations. The purpose of the paper is to give students the opportunity of examining a topic from two divergent points of view by putting themselves in the shoes of the one doing the interpreting.

The basic positions of the Creationist and Evolutionist are reviewed at this time.

There are six parts to the paper: introduction, the empirical evidence, the creationist interpretation, the evolutionists interpretations, the student's analysis of the evidence and an evaluation. Empirical information is material both sides agree upon. For the interpretation sections, the student answers the question that if he were an evolutionist (creationist) how could he use the empirical data to support his position? The students have to put themselves into the shoes of another. It forces them to think along guidelines that are foreign to most of them, definitely a new experience. In the analysis section, the student is free to examine the empirical evidence from his own worldview. In the last section they are asked to evaluate the validity of the learning experience.

Grading is broken down into two parts - Mechanics and Content. Mechanics is obvious. Content involves the reporting of the empirical evidence and the divergent interpretations; and how well the students support their own position. It is important that the student realize that he has free reign in the analysis section. The student is not required to conform to a particular interpretation; rather, it is how well he supports his interpretation that is critical.

Currently, the topic list from which students can choose has over fifty different items, such as, the origin of language, the wholly mammoth, homology and continental glaciers. Once the main topic has been chosen it needs to be narrowed down to one or two aspects. The student can also come up with his own topic, but it has to be a historical scientific issue.

When doing the research, the Empirical information and the Evolutionists side can readily be found in the libraries. The students are encouraged to find Creationist materials on their own; however, finding enough information is a bit difficult. Therefore, each student is supplied with a photo copy of two or three Creationist articles which must be returned when the paper is handed in.

THE INSTRUCTOR'S WORLDVIEW

A week after the research paper is assigned, my worldview is presented as an example of one that has been well thought out. The students are continually encouraged to check the consistency of their own beliefs, they have the conceptual groundwork and the tools for evaluations, they now have the opportunity to analyze the worldview of their instructor. Exposing your worldview for critical examination is helpful in pointing out blind spots that you may not be aware of. This has proven to be a valuable exercise for all involved.

ATTITUDE

The preceding involved the mechanics and rationale behind the Worldview Approach to Critical Thinking. However, there is one final element. The teacher needs to cultivate an **attitude of openness** within the classroom. There needs to be a willingness to listen to someone else's ideas without condemnation. That does not necessarily mean acceptance of the those ideas; rather, a readiness to hear the other person out. In addition, students and teachers need to be challenged to apply the evaluation tools to gain insight regarding the validity of the new and/or different ideas. The student needs to feel comfortable sharing the depths of his heart. A student will remember the attitude of the class long after he has forgotten the content material.

The above is the Worldview Approach to Critical Thinking and how I have woven the material into my physics course.

STUDENT REACTION

This year as part of their year end evaluation, the students evaluated the Discovery paper and the Research paper. Eighty-five students filled out the evaluations; the percentage break down is below. The numbers speak for themselves.

Paper	\ Very Helpful	\ Helpful	\ Some Good	\ Not Worth It
Discovery	34.5%	21.4%	32.2%	11.9%
Research	30.2%	34.9%	23.3%	11.6%

The following are some of the positive comments students made in the evaluation section of their research paper.

> I think that this was a valuable means of examining a controversial topic [Origin of Language]. Being able to compare and contrast two sides of an issue and then interpreting a conclusion on my own expands [one's] intellect. We sometimes need to think about things that we never do. It exercises the brain and broadens the mind [Athena, 1st period].

> Researching this topic was a rewarding way to examine both the evolutionist's side and the creationist's side on origins. It enforced the lesson that there is more than one way to look at a subject. All paths and reasons need to be examined before a judgement is made. I used to believe the evolutionists side on the origins of coal. Now after learning the creationist side my thoughts on the formation have broadened. I'm not really for one side or the other, even though they are both very influential. The creationist has a more thorough explanation however [Annie, 7th period].

> I feel that both creationists and evolutionists have decent arguments for the origins of birds. I believe that this means of examining a controversial topic was pretty good. I was able to get a good solid feel for what both sides felt and the points that they wanted to get across [Scott, period 5A6A].

In general, student comments were favorable to being able to examine more than one side of an issue and give their own analysis. However, regarding the research paper there were some students who did not think the project was worth it, as the evaluation figures show, or that some part of the project was objectionable.

> I also think that this assignment was inappropriate for a public school. I realize that to be fully educated that we should know about all sides, but I chose to attend a public school because at this point I also choose not to be educated in the creationist point of view [Bekki, 1st period].

Of the negative comments, Bekki's was the most articulate. Other students just made a blanket statement that they did not learn anything. Her paper was also one of the best written. This is the first time in three years that such a comment has come up. The purpose of this approach is not to teach a particular worldview or particular interpretation; rather it is to show the effect of the worldview on interpretation. Because at the extremes, these two sides (Creation - Evolution) are diametrically opposed, thereby providing an excellent example of very different interpretations of the same evidence. If the worldviews are very similar then differences in the interpretations will be subtle and not very easy for a beginner to discern. Regretfully, anytime there is a controversial topic, there is a possibility that someone will not want to have anything to do with one side or the other. But for a person to get a real feel for the full range in interpretive possibilities examining an undesired position may be necessary. However, the person is not required to believe it.

Another student anonymously wrote on the year end evaluation, regarding the discovery paper, "I object to airing my religion to the criticisms of others." At no time was a particular worldview ever "criticized;" therefore, the comment is confusing. If it is a matter of privacy, the discovery papers were never shared with anyone. The teacher was the only one to read the papers. However, do not let a minority of negative comments detract from the numbers; most students (88%) felt the worldview papers were helpful.

At present, I have no hard data regarding the Worldview Approach as a whole. Also, I cannot say for certain that anyone has changed their worldview because of this approach. The above data, from this year's evaluations (1994), is the most objective evidence available. However, based on comments written by students in my yearbook and from individual conversations, I am more than satisfied with the impact that this approach has made. The comments have been edited, and only that information pertaining to worldviews is presented. Do not forget that these comments were written in my yearbook and were unsolicited.

This first comment is precious because Jamie was not pleased with the worldview material as we went through the year; but here are her comments at the end.

> Mr. Wiz, It really has been a wonderful year, and I grudgingly admit that even the world view part of the course was enjoyable. Your gentle approach to world view did help me listen to what you said, even though at times I may have seemed angry [Jamie, 9th period].

> Hey Mr. Wiz, ... Thanks for showing me there's more to life than just physics: worldview. I learned a lot about what I think and my views in your class, something I never expected from a physics class [Bridget, 1st period].

> Mr. Wiz, ... You have taught me physics and many life lessons at the same time. ... I now look at things in a different perspective and I thank you for that and everything [Michaelann, period 5A6A].

> Mr. Wiz, You have shown me how to find out what and why I believe in something. You have helped to show me the most important thing about school is not test grades but on what I have learned. And I have learned a lot [Carl, period 5A6A].

What more can I say?

CONCLUSION

The premise upon which the Worldview Approach to Critical Thinking is based is that **beliefs are an integral part of the interpretive process**. The three major concepts that the approach hinges on are 1) dividing of science into two categories: empirical and historical, 2) the effects of the worldview on interpretation, and 3) how to evaluate worldviews. Critical to the success of this approach is that the teacher promote an attitude of openness within the classroom. The material is supplemental and can be woven into any course that involves the interpretation of evidence. As an educator, I have found this approach to be very exciting, because it teaches students to become critical thinkers and not parrots. As the students above have indicated, they have been challenged to a) broaden their horizons, b) see the world in a new light, and c) look further than they ever have before.

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